HEWLETT PACKARD

RTE Driver DVR37 For HP 59310B Interface Bus

Programming and Operating Manual

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Each reprinting of this manual will incorporate all past Updates, however, no new information will be added. Thus, the reprinted copy will be identical in content to prior printings of the same edition with its user-inserted update information. New editions of this manual will contain new information, as well as all Updates.

To determine what manual edition and update is compatible with your current software revision code, refer to the appropriate Software Numbering Catalog, Software Product Catalog, or Diagnostic Configurator Manual.

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GENERAL INFORMATION

SECTION I

1-1. GENERAL DESCRIPTION

This manual contains information you need to write FORTRAN or Assembly Language application programs that interface with RTE Driver DVR37. Calling the driver through Real-Time BASIC is not covered here, but is covered in the HP-IB Users Manual.

DVR37 is a general-purpose driver for the HP 59310B Interface Bus. Although DVR37 maintains overall control of simple HP-IB functions, it does not attempt to resolve the bus contention problems that may arise due to the multiprogramming functions of RTE. It is your responsibility to maintain continuity in such operations.

The driver does not support the interleaving of data transfers through more than one program when more than one program is operating the HP-IB. If you anticipate this type of bus activity, you would be wise to control all logical unit accesses through the RTE LU Lock feature, or synchronize bus activity with Resource numbers.

Note that DVR37 can operate more than one HP 59310B I/O card.

There are two modes of operation supported by DVR37: Auto-addressing and Direct I/O. You select one of the modes by specifying a particular Logical Unit Number (LU) which you have assigned during RTE system generation. For example, if a device is to be used under Auto-addressing, you would configure the device address into the subchannel part of a logical unit number during system generation. Then, when that particular LU was specified in an EXEC call, DVR37 would be able to construct the proper address for that device.

For Direct I/O to the bus, an LU with a subchannel of zero is specified in the EXEC call. Refer to figure 1-1 for an example of LU-to-Device association.

1-2. AUTO-ADDRESSING

In the Auto-addressing scheme, DVR37 assumes complete control of the HP-IB. This includes control modes and device addressing. You only need be concerned about the data being transferred to or from the device.

1-3. DIRECT I/O

When using Direct I/O to the bus, you are responsible for all command and addressing requirements. This mode is usually used to address multiple listeners or to provide universal or selected device control commands.

Note that when using the Auto-addressing scheme, the driver assumes complete control of the HP-IB, while in the Direct I/O mode of operation the driver provides none. As such, any user mix of the two modes in a single application must be approached with caution. In this situation, the overall activity of bus control lines must be considered, with the responsibility for continuity of operations resting with you.

1-4. OPERATING ENVIRONMENT

The operating environment for the DVR37 must be an HP 1000 Computer System, one or more HP 59310B Interface Bus Kits, and an RTE-M, RTE-II, RTE-III, or RTE-IV Operating System.

1-5. COMPONENTS

In addition to this manual, the following components are included with HP Driver DVR37:

Item	HP Part Number
Driver DVR37 Binary Tape without SRQ	59310-16002
Driver DVR37 Binary Tape with SRQ	59310-16003
RTE HP-IB Utility Routine Binary Tape	59310-16004

1-6. APPROXIMATE LENGTH

The approximate lengths of both versions of the driver and utility library are as follows:

	DVR37 w/SRQ	DVR37 w/o SRQ	Utility Library
Octal	2300	1700	1300
Decimal	1216	960	704

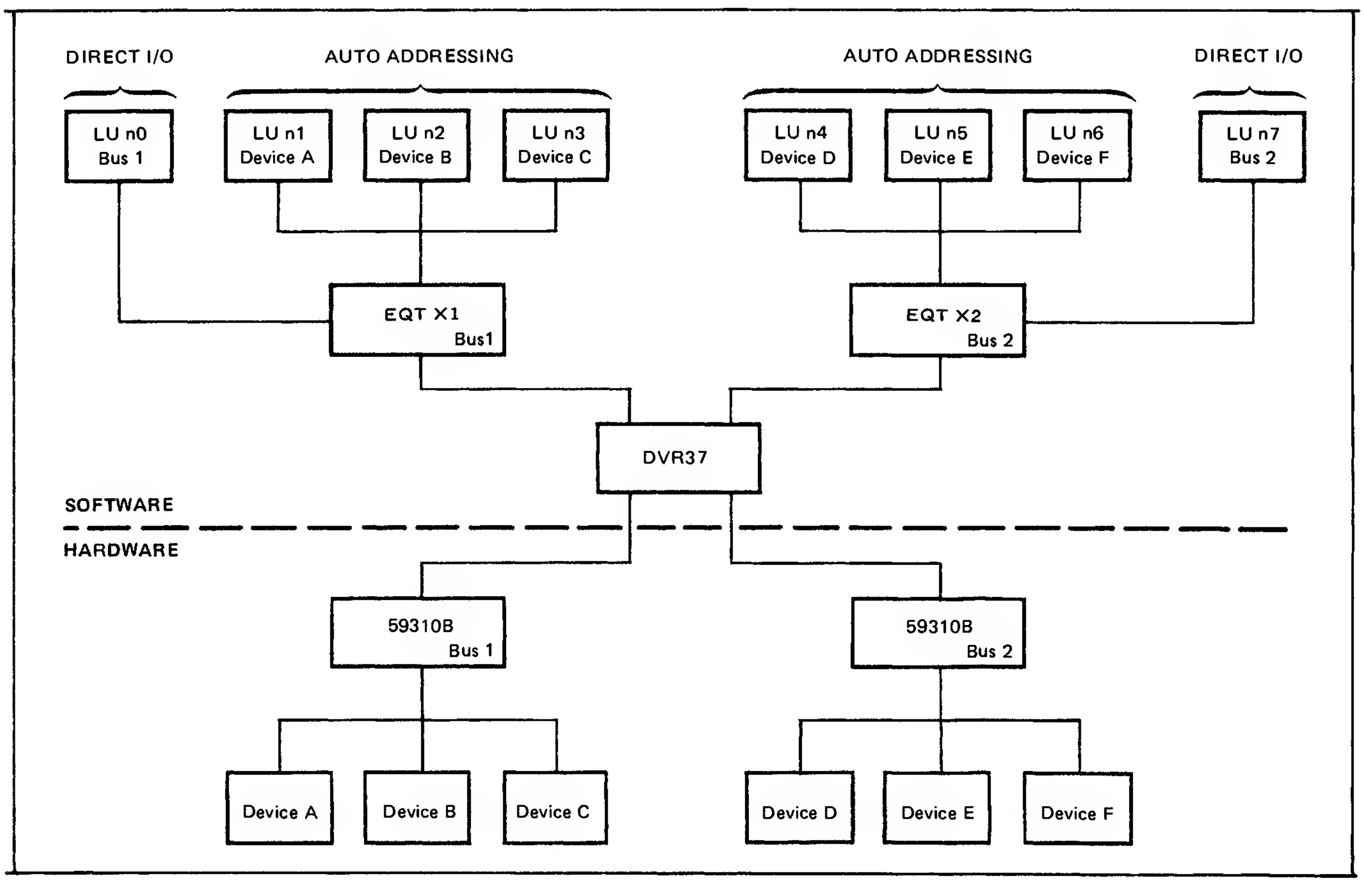


Figure 1-1. LU — Device Association

APPLICATION INFORMATION

SECTION II

2-1. GENERAL

This section details the calls (requests) to the driver and describes any results of hardware/software interaction where the hardware may influence software techniques. BASIC calls are not covered here; refer to the HP-IB Users Guide.

This section uses mnemonics to describe certain functions and control lines of the HP-IB and driver. The following is a list of the most common.

Mnemonic	Meaning
DAV	Data Valid
NRFD	Not Ready For Data
NDAC	Not Data Accepted
IFC	Interface Clear
ATN	Attention
SRQ	Service Request
REN	Remote Enable
EOI	End or Identify
CR	Carriage Return
LF	Line Feed
EOR	End-of-Record

2-2. AUTO-ADDRESSING REQUESTS

In the Auto-addressing mode, DVR37 assumes complete control of the HP-IB. This includes control modes and device addressing. You only need be concerned about data being transferred to, or received from the end device through the EXEC calls.

2-3. READ/WRITE REQUESTS

The Read/Write Requests (see table 2-1) will transfer data and/or universal commands through the bus to or from the specified device. DVR37 first unaddresses all non-participating devices and then establishes a data path and transfer direction according to the request code (Read or Write) and logical unit. If any command exists in the command buffer, it is automatically placed on the bus lines in the Command Mode (Attention Line true). Note that each command is an 8-bit byte (see table 2-5), allowing two commands to appear in a single buffer word. Then, if any data exists in the data buffer, it is automatically placed on the bus lines in the Data Mode (Attention Line false) according to the format specified in the ICNWD parameter (bit 6 through 10). If you specify the format as Transparent mode, the ASCII mode logic of the I/O card is enabled. This allows the special control functions shown in table 2-2 to be enabled by a data word in the data buffer. (Transparent mode means that the driver does not alter the data in any way, nothing is added or subtracted.) EOR

indications are expected or provided by the driver according to (1) the type of data mode selected (i.e., binary data record), and (2) the device configuration word which is described later. In general, EOR conventions are as follows:

Fixed Length Binary Record (ICNWD = 100B+lu)	—	EOR is supplied by the driver by asserting the HP-IB EOI line per the CNFG word.
ASCII Data Record (ICNWD = 0B+lu)	—	EOR is supplied by the driver as a CR/LF at the end of the data buffer.
Transparent Mode ASCII (ICNWD = 2000B+lu)	—	EOR is supplied by the user. If LF appears in the data buffer, it serves as the EOR indicator.
Transparent Mode Binary (ICNWD = 2100B+lu)	—	EOR is not supplied at all.

Refer to paragraph 2-8 for more information on End-of-Record formats.

Table 2-1. Auto-Addressing Read/Write Request

ASSEMBLY LANGUAGE

```
JSB EXEC
DEF *+[7,8,9]
DEF ICODE
DEF ICNWD
DEF IDBFR
DEF IDLNG
DEF ICBFR
DEF ICLNG
(DEF IPRM1)
(DEF IPRM2)
```

CALL EXEC(ICODE,ICNWD,IDBFR,IDLNG(,IPRM1(,IPRM2))

Where:

ICODE = Function Code
1 = Read, 100001 = Read and do not abort on error
1 = Write, 100002 = Write and do not abort on error

ICNWD = Control Word =

15	14	13	12	11	10 9 8 7 6	5 4 3 2 1 0
0	0	0	0	0	Sub-Function	Device LU

lu = bits 0-5 (octal LU number of HP-IB device)
xx = bits 6-10 Function Code (octal)
- 00 = ASCII data record
- 01 = Fixed length binary
- 20 = Transparent mode ASCII
- 21 = Transparent mode binary

z = bit 12
- 0 = single buffer I/O request
- 1 = double buffer I/O request (not recommended with new design)

IDBFR = Address of first word of input/output buffer

IDLNG = Input/output buffer length in either characters or 16-bit words
- n = Words
- −n = Characters
- 0 = No data buffer

IPRM1 = 0 No secondary address (see below for secondary address = 0)
1-31 Secondary addresses 1-31 inclusive
140B-177B Secondary addresses 0-31 inclusive

Other values of IPRM1 will produce unpredictable results.

IPRM2 = reserved

Note: Use direct addressing I/O requests to send command buffers to the bus.

Table 2-2. Special Control Functions

ASCII CODE	OCTAL CODE	FUNCTION
ESC	33	Interface Clear (IFC)
Control B	02	Remote Enable (REN)
Control C	03	Local Enable (not REN)
Control N	16	Command Mode (Attention on)
Control O	17	Data Mode (Attention off)
LF	12	Line Feed (EOR)

NOTE

The above codes will cause special actions to occur on the 59310B I/O card when included in a data buffer and under transparent mode. Since the only software supported function above is LF, extreme caution should be taken by the user to insure the remaining codes are not used.

The functions shown in table 2-2 are enabled in the ASCII Transparent mode for both Auto-Addressing and Direct I/O Read/Write Requests.

2-4. CONTROL REQUESTS

You use control requests (table 2-3) to establish selected device and driver control. Device control requests act in accordance with HP-IB design standards, producing predicted results from devices that respond according to those standards. It is your responsibility to ensure that the programmed requirements are within the realm of the device.

Table 2-3. Auto-Addressing I/O Control Request

<table>
<tr><td>ASSEMBLY LANGUAGE</td><td rowspan="2">Where:

ICODE = Function Code
3 = I/O Control

ICNWD = Control Word (00xxlu)

lu = bits 0-5 (octal LU number of HP-IB device)
xx = bits 6-10 Function Code (octal)
00 = Selected Device Clear
01 = Issue EOR
06 = Dynamic device status
11 = Device line spacing
16 = Set REN true
20 = SRQ schedules program in IPRAM (unbuffered I/O only)
21 = Disable function code 20
25 = Configure driver word, this device only
27 = Clear driver configuration, this device only

IPRAM = Optional parameter. When Function Code = 11, IPRAM = positive number of CR/LF's to be issued to device, or negative integer to generate a form feed. IPRAM = 0 to suppress appending LF to data on next write.
When Function Code = 20 (see example) IPRAM = address of the program name.
When Function Code = 25 (see example) IPRAM = Configuration Word (see figure 2-1).</td></tr>
<tr><td>JSB EXEC
DEF *+4
DEF ICODE
DEF ICNWD
DEF IPRAM</td></tr>
<tr><td>FORTRAN</td><td>DIMENSION IREG(2)
EQUIVALENCE (IREG,REG)
REG = EXEC(ICODE,ICNWD,IPRAM)</td></tr>
</table>

Note: If ICODE = 20, use Utility Routine.

Example

```
ICODE DEC 3
ICNWD OCT 251u
IPRAM OCT 17400
```

```
ICODE DEC 3
ICNWD OCT 201u
IPRAM DEF *+1
      ASC 3,PROGA
IARB  DEC 77B
```

The following is a summary of the available control requests shown in table 2-3.

- Selected Device Clear (xx = 00). Causes the cooperating device to reset itself to a predetermined state. The associated device is addressed and the SDC command is issued (see table 2-5).

- Issue EOR (xx = 01). The specified device is addressed and the EOI line is set true. If device action is awaiting the EOR, this has the effect of completing a transmission.

- Dynamic Device Status (xx = 06). A specific HP-IB device may provide 8-bits of status in response to a serial poll by the driver. The status byte will be posted at EQT word 5 (see figure 2-3) which is available to you via a status request. Refer to the RTE manual and individual device manual for information on the recovery and meaning of such status. Note that this status is also returned in the registers (see paragraph 2-12).

- Device Line Spacing/Form Feed (xx = 11). This request provides the capability of specifying line spacing or form feed to a device.

- REN true (xx = 16). Sets the REN bus line high. Some HP-IB devices require the REN line to be true before they will send or receive information under program control. See individual device manual for further information.

- Arm Service Request (SRQ), Alarm Program (xx = 20). This request will cause one of your programs (see IPRAM in table 2-3) to be scheduled in response to a device service request. An alarm program may exist for each auto-addressable device as desired. Serial polling is the responsibility of the driver in determining which device caused the SRQ. However, the action to be taken is controllable by you. Refer to paragraph 2-13, Interrupt Service. Unbuffered I/O must be used for this request.

NOTE

IPRAM = Address of 5-character program name. If the name is less than 5 characters, substitute trailing blanks for those missing. An arbitrary value to be passed to the SRQ program immediately follows the program name.

When the alarm program is activated, it will be passed several parameters provided to the driver during the serial poll. This information is retrievable via the RTE subroutine RMPAR and is set up as follows (refer to the RTE manual):

Parameter one = 8-bit status byte (EQT word 5, bits 0-7)
Parameter two = 5-bit device address (subchannel) of interrupting device
Parameter three = EQT address of associated bus
Parameter four = Arbitrary value to be passed to SRQ program

- Disable SRQ Alarm Service (xx = 21). This request cancels the SRQ Alarm Service. Any future SRQ interrupts will be ignored.

- Configure Driver Word (xx = 25). This request configures the driver word for specific devices. The configuration word, which is shown in Figure 2-1, defines such things as DMA usage and immediate driver reaction to service requests. (Refer to paragraphs 2-8, 2-9, and 2-10 for more information.) A specific configuration word is active only during a request to its respective device and overrides any other prevailing conditions. If not defined, the configuration word defaults to:

```
0 001 111 000 0xx xxx
S RDI JOP E
```

Which is:

S = 0 = Disable high priority response to SRQ interrupt
R = 0 = Disable I/O restart attempt
D = 0 = Disable DMA usage
I = 1 = Require EOI from device
J = 1 = Expect EOI with last data byte
O = 1 = Issue EOI to device
P = 1 = Issue EOI with last data byte
E = 0 = Allow occurrence of an error to abort current program
x = Not used

- Clear Configuration (xx = 27). This request clears all driver knowledge of specific device characteristics which have previously been established for this device. This includes alarm program status as well as the device configuration word.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
S	R		I	J	O	P	E	0			NOT USED				

S = 0 — Disable S = 1 — Enable		Driver to abort a currently active I/O request in order to service an SRQ interrupt.
R = 0 — Disable R = 1 — Enable		Driver to attempt to restart an I/O request which was aborted, as above. R-bit is functional only if S-bit = 1.
D = 0 — Disable D = 1 — Enable		DMA use for I/O requests.
I = 0 — Don't require I = 1 — Require		EOI indication from device for end of transmission.
J = 0 — J = 1 —	Expect EOI	After / With last input byte of data.
O = 0 — Don't issue O = 1 — Issue		EOI indication to device at end of transmission.
P = 0 — P = 1 —	Issue EOI	After / With last output byte of data.
E = 0 — Allow E = 1 — Disallow		Occurrence of an error to abort current program.

Figure 2-1. Format of IPRAM in Auto-Addressing I/O Control Request (ICNWD = 25)

2-5. DIRECT I/O REQUESTS

This mode of operation provides you with direct access to the HP-IB bus, permitting special bus manipulation and device access. All device addressing and their commands are your responsibility and are carried out through the extra parameters shown in table 2-4, Direct I/O Read/Write Requests. Refer back to table 2-2 for special functions available in ASCII Transparent mode. Refer to table 2-5 for a list of the available HP-IB universal commands.

NOTE

In order for the computer (driver) to effectively manage the various HP-IB devices, it must also assume the role of active controller. As such, each and every driver request will insure this condition is always met.

Table 2-4. Direct I/O Read/Write Requests

<table>
<tr><th>ASSEMBLY LANGUAGE</th><th>CALL EXEC(ICODE,ICNWD,IDBFR,IDLNG(,IPRM1(,IPRM2))</th></tr>
<tr><td>JSB EXEC

DEF *+[7,8,9]
DEF ICODE
DEF ICNWD
DEF IDBFR
DEF IDLNG
DEF ICBFR
DEF ICLNG
(DEF IPRM1)
(DEF IPRM2)</td>
<td>Where:

ICODE = Function Code
1 = Read, 100001 = Read and do not abort on error
2 = Write, 100002 = Write and do not abort on error

ICNWD = Control Word =
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10 9 8 7 6</td><td>5 4 3 2 1 0</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>z</td><td>0</td><td>Sub-Function</td><td>BUS LU</td></tr>
</table>

lu = Bits 0-5 (octal LU number of HP-IB bus)
xx = Bits 6-10 Function Code (octal)
00 = ASCII data record
01 = Fixed length binary
20 = Transparent mode ASCII
21 = Transparent mode binary
z = Bit 12
0 = single buffer I/O request (data buffer only specified)
IPRM1 = reserved
IPRM2 = reserved
1 = double buffer I/O request (command buffer or command and data buffers specified)
IPRM1 = command buffer
IPRM2 = command buffer length

IDBFR = Address of first word of input/output buffer

IDLNG = Input/output buffer length in either characters or 16-bit words
n = Words
−n = Characters
0 = No data buffer

IPRM1 (z-bit=1) = Address of first word of command buffer (see table 2-5)

IPRM2 (z-bit=1) = Command buffer length in either characters or 16-bit words
(2 HP-IB commands = 1 word)
n = 16,383 words maximum
−n = Characters
0 = Command buffer not sent</td></tr>
</table>

Note: If a command buffer is specified, the z-bit must be set to one (1).

2-6. READ/WRITE REQUESTS

In the Direct I/O Mode, a control buffer may be established to provide device addressing, multiple device response, and universal device commands. The driver is constructed such that if any command exists in the command buffer (IPRM2 > 0), it is automatically placed on the bus lines in the Command Mode (Attention Line true). Note that each command is an 8-bit byte (see table 2-5), allowing two commands to appear in a single buffer word. Then, if any data exists in the data buffer, it is automatically placed on the bus lines in the Data Mode (Attention Line false). Therefore, the driver automatically takes care of outputting commands and data as required.

When you place the HP-IB in the Command Mode (i.e., a command exists in the command buffer), it will process all data placed on its data lines as either device addresses or as universal commands. Associated with each programmable device attached to the HP-IB is an 8-bit ASCII coded address. Each device that transmits data is termed a "talker" and has a unique "talk address" in the range of octal 100 to 136. Similarly, all devices that receive data have an associated "listen address" in the range of octal 40 to 76. Before data can be actively transmitted, a talker and at least one listener must be established. This is accomplished by issuing a "talk address" followed by a "listen address". If it is not certain which listeners may be active on the bus, the "unlisten" command (octal 77) may be issued prior to establishing the new listener. In fact, it is generally good practice to do this anyway to insure that only the proper devices are active. Since there may only be a single talker on the bus at a time, it is generally unnecessary to issue the "untalk" command when establishing a new talker. The occurrence of a "talk" address in the command stream is sufficient to unaddress a prior talker when addressing the new one.

Any of the various HP-IB defined commands which exist may be included by the user in the command buffer at the users discretion. See table 2-5 for a list of available commands. Note that EOR indications are expected or provided by the driver according to (1) the type of data mode selected (i.e., binary data record), and (2) the device configuration word which is described later. In general, EOR conventions are as follows:

Fixed Length Binary Record (ICNWD = 100B+lu)	— EOR is supplied by the driver by asserting the HP-IB EOI line per the CNFG word.
ASCII Data Record (ICNWD = 0B+lu)	— EOR is supplied by the driver at the end of the data buffer. The EOR is CR followed by a LF.
Transparent Mode ASCII (ICNWD = 2000B+lu)	— EOR is not supplied by the driver. If LF appears in the data buffer, it serves as the EOR indicator.
Transparent Mode Binary (ICNWD = 2100B+lu)	— EOR is not supplied at all.

Refer to paragraph 2-8 for more information on End-of-Record formats.

Table 2-5. HP-IB Universal Commands

COMMAND	ACRONYM	OCTAL CODE	FUNCTION
Talk Address	TLK	100-136	Establish addressed device as talker on the bus. Any previous talker is automatically unaddressed.
Listen Address	LSN	40-76	Add addressed device to current list of listeners on the bus. If no listeners exist, the addressed becomes the only one active.
Untalk	UNT	137	Causes the current talker to be unaddressed.
Unlisten	UNL	77	Causes all current listeners on the bus to be unaddressed.
Group Execute Trigger	GET	10	Causes all currently addressed devices to initiate a pre-programmed action.
Select Device Clear	SDC	04	Causes all currently addressed devices to reset to a pre-determined state.
Universal Device Clear	DCL	24	Causes all responding devices to return to a predetermined state (Devices need not be addressed).
Go To Local	GTL	01	Causes the currently addressed devices to return to local control.
Local Lock Out	LLO	21	Causes all responding devices to disable their front panel local-reset buttons (Devices need not be addressed).
Serial Poll Enable	SPE	30	Establishes serial poll mode, such that all cooperating devices, when addressed, will provide status information. An ensuing read will take a single 8-bit byte of status.
Serial Poll Disable	SPD	31	Terminates Serial Poll returning cooperating devices to their normal data transmission state.
Parallel Poll Configure	PPC	05	Assigns an HP-IB DIO line to a cooperating device of group of devices for the purpose of responding to a parallel poll.
Parallel Poll Unconfigure	PPU	25	Resets all parallel poll devices to a predetermined state.
Parallel Poll Enable	PPE	140-157	Enables a cooperating device to have its parallel poll response configured.
Parallel Poll Disable	PPD	160	Disables cooperating devices from responding to a parallel poll.

The remaining unspecified codes are reserved for future use and should not be used indiscriminately in any control buffer. This will avoid future difficulties.

2-7. CONTROL REQUESTS

Control Requests (see table 2-6) in the Direct I/O mode relate to bus activity instead of device activity. That is, a Direct I/O Control Request will affect the entire bus and all addressed devices connected to it. It is your responsibility to insure that the programmed requirements are within the realm of the connected devices.

Table 2-6. Direct I/O Control Request

ASSEMBLY LANGUAGE	Where:
JSB EXEC DEF *+3 DEF ICODE DEF ICNWD	ICODE = Function Code 3 = I/O Control ICNWD = Control Word (00xxlu) lu = Bits 0-5 (octal LU number of HP-IB bus) xx = Bits 6-10 Function Code (octal) 00 = General bus clear 01 = Issue EOR 06 = Dynamic bus status 16 = Set REN true 17 = Set REN false 25 = Configure driver 27 = Clear driver configuration 30 = Parallel poll
FORTRAN	DIMENSION IREG(2) EQUIVALENCE (IREG,REG) REG = EXEC(ICODE,ICNWD)

The following is a summary of the available control requests shown in table 2-6.

- General Bus Clear (xx = 00). The driver issues an interface clear (IFC) command followed by the universal device clear command (see table 2-5). The overall effect is to clear the HP-IB together with all responding devices.

- Issue EOR (xx = 01). The driver sets the EOI line true which provides an EOR to all responding devices.

- Dynamic Bus Status (xx = 06). Status from the HP-IB I/O card is returned in EQT word 5 which is shown in figure 2-3. This status word is available to you through an RTE status call. Refer to the RTE manual.

- REN true (xx = 16). Sets the REN bus line high. Some HP-IB devices require the REN line to be true before they will send or receive information under program control. See individual device manual for further information.

- REN false (xx = 17). Sets the REN bus line low. Resets all currently addressed devices from remote to local control.

- Configure Driver (xx = 25). This request provides the capability of defining a driver configuration word which controls device actions for direct I/O requests. If this request is not made, the driver configuration word will default to:

```
0 0n1 111 000 0xx xxx
S RDI JOP E
```

  Which is:

  S = 0 = Disable high priority response to SRQ interrupt.
  R = 0 = Disable I/O restart attempt.
  D = 0/1 = DMA not used/used for Direct I/O request. If DMA was specified at generation n=1, otherwise n=0.
  I = 1 = Require EOI indication from device.
  J = 1 = Expect EOI to occur with last byte.
  O = 1 = Issue EOI indication to device.
  P = 1 = Issue EOI indication with last byte.
  E = 0 = Allow occurrence of an error to abort current program.
  x = Not used.

- Clear Driver Configuration (xx = 27). This request clears all driver knowledge of specific device characteristics which have previously been established by control requests and resets the driver configuration word to the default value shown above.

- Parallel Poll (xx = 30). This request initiates a parallel poll. Devices that have been previously parallel poll enabled will respond to the poll on specific DIO lines according to their parallel poll configuration. Up to eight unique devices or groups of devices may respond to this parallel poll. Their response will be stored in the lower byte of EQT word 5 and returned in the A-register.

2-8. END-OF-RECORD

The following End-of-Record (EOR) conditions apply to both the Auto-Addressing and Direct I/O modes of operation.

EOR for ASCII data is in the form of a carriage return/line feed (CR/LF) command. For binary data, EOR is indicated by a signal on the HP-IB EOI line. In order to properly set up the driver to respond to the EOI line, a Control Request should be the first call issued to each I/O device for EOI configuration. If not, the previously defined defaults will be used. Refer to figure 2-1, bits 9-12.

EOR is explained under two conditions, Read and Write Requests.

2-9. EOR WHEN TRANSMITTING (WRITE)

There are four types of format specified:

a. ASCII with EOR
   CALL EXEC (ICODE,LU+0B, ...)

   The EOR is a CR followed by a LF sent with EOI line asserted.
   CR/LF is appended to data unless a back arrow appears as the last character.
   The driver configuration word is not used.
   Card ASCII logic is disabled.

b. Binary with EOR
CALL EXEC (ICODE,LU+100B, ...)

EOR is determined by configuration word bits O and P (see figure 2-1).

In this format the EOR is an EOI.

Card ASCII logic is disabled.

O-bit = 0		— Don't issue EOI.
O-bit = 1, P-bit	= 0	— Issue EOI after last output byte of data. Since EOI must be transmitted with a data byte for handshaking a data byte of 0 is issued by DVR37 for this purpose, then discarded.
O-bit = 1, P-bit	= 1	— Issue EOI with last output byte of data. That data byte is good.

Note: The above is recommended configuration.

c. ASCII without EOR
CALL EXEC (ICODE,LU+2000B, ...)

EOR is not supplied. EOI is issued by the interface card when a LF occurs in the data.

The driver configuration word is not used.

Card ASCII logic is enabled.

d. Binary without EOR
CALL EXEC (ICODE,LU+2100B, ...)

EOR is not supplied.

Card ASCII logic is disabled.

2-10. EOR WHEN RECEIVING (READ)

When receiving data the driver must be able to handle several device situations.

- The device may set the EOI line with the last byte of data it transmits — in this case the data is good.
- The device may set the EOI line after the last byte of data it transmits. Since EOI must be transmitted with a data byte for handshaking conventions, the last data byte is assumed meaningless and is discarded by DVR37.
- The device gives no EOR indication at all. It transmits a fixed number of bytes of data and then quits. In this case, transmission ends when a "buffer full" or time out condition occurs.
- If, for example, the request is for 6 characters and the device wants to give 12, the data is terminated after the driver gets its 6 characters due to a "buffer full" condition.

No matter what the situation is, if the word count is reached, or if the device sets the EOI line, the driver terminates the data transmission. In the latter case, the driver always examines the "I" and "J" bits (see Figure 2-1) to see how the device was configured so it knows whether or not the last data byte is good.

There are four types of format specified.

a. ASCII with EOR
CALL EXEC (ICODE,LU+0B, ...)

In this format the data is logically terminated by a LF (CR is ignored). However, the data can also be terminated by the device setting the EOI line; either is acceptable. If an EOI terminates the transfer, J is tested. Card ASCII logic is disabled.

b. Binary
CALL EXEC (ICODE,LU+100B, ...)
CALL EXEC (ICODE,LU+2100B, ...)

In this format the data is received, followed by an EOI. The driver then examines the "I" and "J" bits (see figure 2-1) to see how the device was configured. Card ASCII logic is disabled. Note that both binary formats (w/ and wo/EOR) are identical in the READ mode.

I-bit = 1, J-bit = 1 — Expect EOI with last input byte of data. The last data byte is good data.

Note: The above is the recommended configuration.

I-bit = 1, J-bit = 0 — Expect EOI after last input byte of data. Since EOI must be transmitted with a data byte for handshaking, the last data byte is assumed meaningless and is thrown out by the driver.

I-bit = 0 — Don't require EOI. However, any EOI will terminate data. Under this configuration the absence of EOI is accepted as valid.

c. ASCII without EOR
CALL EXEC (ICODE, LU+2000B, ...)

In this format you usually read as much data as you intend. However, if an LF is present in the data then the Read Request will be terminated at that point. Card ASCII logic is enabled.

2-11. ERROR HANDLING

Error returns are important to you in that you are responsible for making your own error checks and decisions based upon any error indications reported in the A- or B-Registers (bit 15 in the B-Register indicates an error has occurred). The driver will not normally invoke the system to handle any errors. Should an error occur, DVR37 checks if the request is unbuffered. If it is unbuffered, the driver will then check bit 8 (E-bit) of the driver configuration word. If E=1 the error status will be made available to the user in the A-Register. If the request is buffered the request will be aborted.

There are two error conditions where the HP-IB EQT is downed which disables the entire bus.

The first occurs if the driver is buffered or used with class I/O. If it is, you cannot perform error checks on the A- and B-Registers.

The second condition where the EQT is set down is where an SRQ interrupt occurs and a program has not been established to cover it. In this case the driver could be in two states when the SRQ occurs, the HP-IB is downed. If the driver is idle, the bus is not set down. However, the message ILL INT is printed (illegal interrupt).

In all cases the HP 59310B Interrupt line is disabled. You must first correct the condition that caused the problem; then you can issue any driver request which will automatically re-enable the interrupt line.

The B-Register contains a positive number which is the number of words or characters (depending upon which the program specified) actually transmitted. Bit 15 in the B-Register is the error indicator and should be checked after each call to the driver.

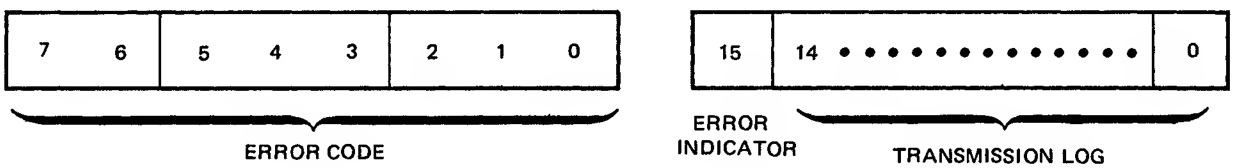
In general, error checking should occur as follows:

- If B-Register, bit 15 = 0, then no error has occurred.

- If B-Register, bit 15 = 1, then an I/O error has occurred, and the error code defining the type of error will be found in the lower 8-bits of the A-Register (see figure 2-2).

NOTE

If a device times-out it is possible to not receive an error indication in the binary mode. For example, if an input EOR is not expected and you have received some data, a time-out will occur but there will be no time-out error indication. The time-out in this case is used to terminate a read operation from a device which does not signal EOR (see paragraphs under 2-10).



Where:

Error codes are set as follows:

1 — I/O device time-out occurred.

2 — IFC detected during I/O request.

3 — SRQ service has aborted I/O request.

4 — Non-existent alarm program.

5 — Illegal I/O request. Bit 12 not set in the control word for a double buffered request.

6 — EQT extension area full, no new device may be added on-line.

Figure 2-2. Error Codes

There are two error conditions that can exist for which an error code is returned in EQT word 5 of the bus on which the error occurs. The EQT5 error codes are:

5: On SRQ interrupt, the driver could not schedule the alarm program specified in the device EQT extension; probably the program is not in the system.

7: No status returned by a device in response to a serial poll; time-out triggers the error.

If either error code occurs, the system console will print:

```
ILL INT xx
```
(illegal interrupt)

where xx is the select code of the HP-IB interface on which the interrupt occurred. This message will be output only if the Driver is idle at the time the interrupt occurs.

Whenever the above message is printed on the system console for an HP-IB related interface or LU, the operator should retrieve EQT word 5 for the particular bus and determine whether there is an error code in the lower byte.

See Appendix A for information on the HP-IB EQT entry.

2-12. STATUS

End-of-operation status is transmitted to the program in the A- and B-Registers. On return from an EXEC call, the A-Register contains EQT 5. Note that bits 0 through 7 of the A-Register will always contain in the HP-IB status.

If there is an error during an I/O or status request, the bits are set as shown in figure 2-2. If the request was a status type (i.e., Dynamic Device Status, Dynamic Bus Status, or Parallel Poll Status), then bits 0 through 7 will be set as shown in figure 2-3.

The status information byte maintained at EQT word 5 is cleared at normal completion of all driver requests except for Dynamic Device and Bus Status, and Parallel Poll Status. Refer to figure 2-3 for these status information formats. Note that, should an error be detected by the Driver, appropriate error status is posted instead. See figure 2-2 for the format.

DYNAMIC DEVICE STATUS

7	6	5	4	3	2	1	0
DI08	DI07	DI06	DI05	DI04	DI03	DI02	DI01
D	S	D	D	D	D	D	D

Where:

S = indicates if the device is requesting service.
D = device status (consult particular device manual)

DYNAMIC BUS STATUS

7	6	5	4	3	2	1	0
DI08	DI07	DI06	DI05	DI04	DI03	DI02	DI01
DAV	NFRD	NDAC	REN	ATN	LSN	TLK	CTLR

Where:

DAV = state of bus signal line; 0/1=HI/LO
NRFD = state of bus signal line; 0/1=LO/HI
NDAC = state of bus signal line; 0/1=LO/HI
REN = state of bus signal line; 0/1=HI/LO=Local/Remote
ATN = state of bus signal line; 0/1=HI/LO=Data/Cmnd
LSN = 59310B listener function; 0/1=Unaddressed/Addressed
TLK = 59310B talker function; 0/1=Unaddressed/Addressed
CTLR = 59310B controller function; 0/1=Inactive/Active

PARALLEL POLL STATUS

7	6	5	4	3	2	1	0
DI08	DI07	DI06	DI05	DI04	DI03	DI02	DI01

Where:

DI01-DI08 = Bus data line status in response to parallel poll.

Figure 2-3. Status Byte Definitions

2-13. INTERRUPT SERVICE

DVR37 is constructed in such a fashion as to expect interrupts at all times, whether or not an I/O operation is in progress. The principal interrupt of concern is the service request (SRQ). If an SRQ occurs while the driver is idle, a table of active alarm service programs is scanned and the associated devices are serial polled to determine the requestor. Once the device is found, the associated service program is scheduled and the driver returns. If an alarm program does not exist or is inactive, the SRQ interrupt is dismissed.

The actual requesting device cannot be determined until a serial poll is performed, which can be conducted only when the HP-IB is idle. This means that you must determine the priority of service requests. Accordingly, if the SRQ occurs in the midst of an I/O request, the configuration word of the currently operating device is examined to determine driver action.

If the S-Bit is clear (see figure 2-1), SRQ interrupt service is held off until completion of the I/O request, at which time it is then serviced. If the S-Bit is set, the current I/O operation is aborted, SRQ is handled, and then the R-Bit is examined. If the R-Bit is set, an attempt is made to restart the aborted I/O request, the success of which is dependent upon the specific device. If the R-Bit is clear, restart is not attempted and abort is indicated in the A- and B-Registers (see paragraph 2-11).

CONFIGURATION INFORMATION

SECTION III

3-1. GENERAL

This section provides RTE generation information for the HP-IB software, supplementing the information provided in your RTE Software System Programming and Operating Manual. Table 3-1 lists the HP-IB software and the standard file names under which these software modules are stored on your disc.

The HP-IB RTE-IV Library, %IB4A, incorporates the HP-IB Utility Routine and the HP-IB Message Subroutine Library (formerly %HPIB and %MESS, respectively) and contains header information, standard HP-IB functions, Basic functions requiring SSGA, and obsolete or backward compatible functions such as HPIB and IBSTS, in separate modules. This allows access to separate functions in the library as needed without loading all modules. For instance, a FORTRAN program may access the standard HP-IB functions module without having to access the Basic functions that require SSGA. Note that %HPIB and %MESS are now obsolete.

3-2. DRIVER CONSIDERATIONS

An HP-IB driver is essential; either of the two listed in table 3-1 can be used. Under no circumstances can both be configured into the same system. The two drivers are identical except that one provides SRQ service and the other does not. The SRQ/TRAP program is used to handle traps in BASIC only.

3-3. GENERATION PROCEDURE

The generation procedure given here follows the same sequence and format as that given in the RTE system manuals.

Table 3-1. RTE HP-IB Software

HP PART NO.	FILE NAME	DESCRIPTION
59310-16002	%1DV37	Driver DVR37 without Service Request (SRQ) capability
59310-16003	%2DV37	Driver DVR37 with SRQ capability
59310-12001	%IB4A	HP-IB RTE-IV Library
92101-12002	%BAMLB	BASIC Memory Resident Library
59310-16005	%SRQ.P	SRQ/TRAP program for BASIC

3-4. PROGRAM INPUT PHASE

After selecting the HP-IB driver to be used, load the driver during RTE system generation as described in the RTE manual for your system. The HP-IB RTE-IV Library can be loaded during this phase. If BASIC is to be used, load the SRQ/TRAP program and the BASIC Memory Resident Library at this time also.

3-5. PARAMETER INPUT PHASE

During the parameter input phase of system generation, except for RTE-M, RTE-II, and RTE-III, make the following entries if BASIC is to be used:

```
TTYEV,17
TRAP,30
```

3-6. TABLE GENERATION PHASE

The table generation phase of system configuration is divided into three parts: Equipment Table entries, Device Reference Table entries, and Interrupt Table entries. Take the steps given in the following paragraphs to configure the HP-IB driver into the RTE system being generated.

3-7. EQUIPMENT TABLE (EQT). Make an EQT entry for each interface card as follows:

1. Determine the I/O slot for the HP-IB Interface Card and note the <select code> of the slot. Select codes are the numbers marked on the slots that run from octal 10 to octal 77. Select codes below 10 are used internally by the system. Select codes above octal 25 are in the I/O extender.

2. Determine the number of EQT extension words required for your application. Calculate the number of extension words required as follows:

   Number of EQT extension words = 7n + 25 (Maximum = 255)

   where:

   n = the number of auto-addressable devices to be connected to the HP-IB.

   Be sure to include enough extension words to allow for adding devices to the system at a later date. Adding extension words requires regenerating the system, which is a more time-consuming procedure than simply adding the new information to available extension area.

3. If desired, specify buffering option B. Buffering provides automatic error handling; not buffering permits you to handle errors in your programs. Buffering DVR37 is not recommended.

4. Determine the maximum time-out value for the slowest device on the bus. T = xxxx in tens of milliseconds. Always supply a time-out value for each equipment table entry.

DMA is not specified at generation time, because the driver bases DMA selection on the configuration word: the device configuration word for auto-addressing and the bus interface card configuration word for direct addressing.

Make each equipment table entry as follows:

```
*EQUIPMENT TABLE ENTRY
   .
   .
EQT n?
sc,DVR37,B,T=xxxx,X=yy
   .
```

where:

n = the EQT number assigned by the RTE system.
sc = Select Code of bus interface card.
B = Buffering option (not recommended for bus).
T = Time-out.
X = EQT extensions.

If you do not want the B option, omit the letter and the comma. Repeat the above steps for each bus interface card in your system.

3-8. DEVICE REFERENCE TABLE (DRT). The Device Reference Table cross-references the device logical unit number (LU) to the EQT entries. Make the appropriate DRT entries as follows:

```
*DEVICE REFERENCE TABLE
   .
   .
   .
lu=EQT#?
n,m
   .
   .
```

where:

lu = Logical unit number to be assigned to a bus device.

n = EQT entry number you assigned to the bus interface card.

m = EQT subchannel number = decimal device address.

Note the following:

1. Assign an LU number and subchannel 0 to the bus interface card. Subchannel 0 need not agree with the address set on the card; the driver uses it only to enable the card to control the bus remote enable line.

2. For the auto-addressing mode, assign an LU number and a non-zero subchannel number to each bus device. Note that the software subchannel number of each device must equal its hardware address and must be a decimal number from 1 through 31.

3. Direct I/O and auto-addressing modes can both be used as long as EQT subchannel 0 is assigned to the bus itself and non-zero EQT subchannels are assigned to the individual bus devices.

3-9. INTERRUPT TABLE. The Interrupt Table allows you to establish interrupt links that tie the select code to its EQT number. Make the table entries as indicated below:

```
*INTERRUPT TABLE
  .
  .
  .
sc,EQT,n
  .
  .
```

where:

sc = Select Code of bus interface card.

n = EQT entry number previously assigned to the card.

Repeat the table generation entries for each bus interface card in your system.

THE HP-IB EQUIPMENT TABLE ENTRY

APPENDIX A

Each equipment table entry is made in the form:

```
sc,DVR37,T=nnn,X=xx
```

where:

sc = Select code of HP-IB interface card

T = Time out value

X = EQT extension
- xx = 10+3* # of devices on bus (up to Rev. 1826)
- xx = 12+5* # of devices on bus (from Rev. 1840 – Rev. 1940)
- xx = 18+7* # of devices on bus (255 words max) (from Rev. 1940 — Rev. 2126)
- xx = 25+7* # of devices on bus (255 words max) (from Rev. 2126)

The EQT entry is a 15 word block as shown in figure A-1.

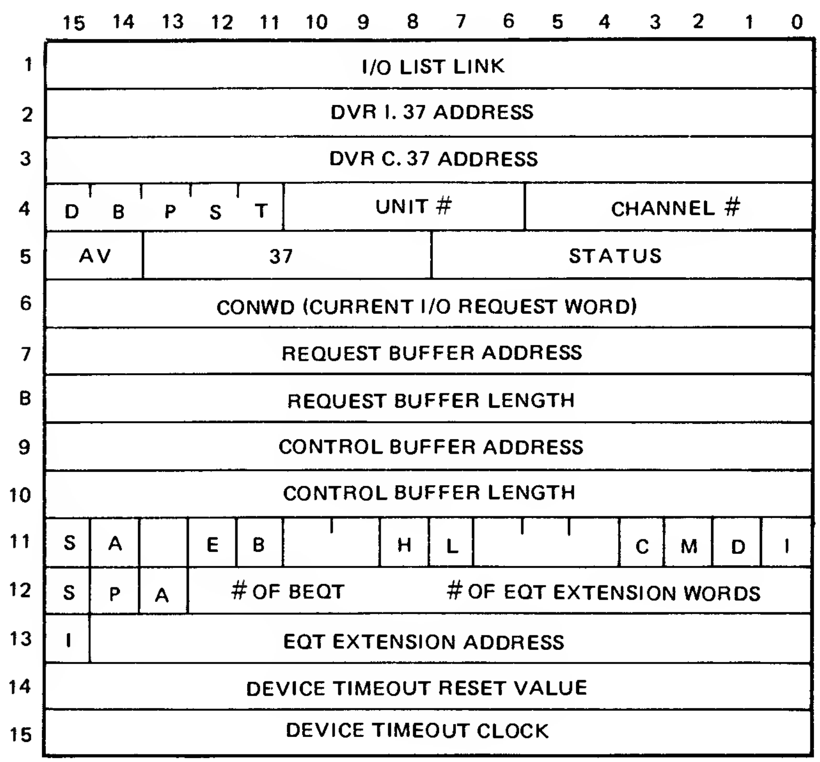


Figure A-1. HP-IB EQT Entry

Word 4	D	=	DMA assigned during generation, 1 = Yes
	B	=	Buffering on, 1 = Yes
	P	=	PWR Fail serviced by DVR, 0 = No
	S	=	Time-out serviced by DVR, 1 = Yes
	T	=	Time-out occurrence, 1 = Yes
	Unit #	=	Unit or subchannel, present request
	Channel #	=	Select code of HP-IB card, present request
Word 5	AV	=	I/O controller availability
	37	=	HP-IB (device type)
	Status	=	Status byte
Word 11	S	=	SRQ service in progress, 1 = Yes
	A	=	I/O request aborted to service SRQ, 1 = Yes
	E	=	Expect/issue EOR at end of current I/O, 1 = Yes
	B	=	Expect/issue EOR with last data byte of current I/O, 1 = Yes
	H	=	Enable ASCII mode I/O card logic, 1 = Yes
	L	=	Suppress line feed. Only bit 7 of BEQT1 is checked
	C	=	Enable CR/LF post processing, 1 = Yes
	M	=	Data mode, 1 = ASCII, 0 = Binary
	D	=	DMA active on pending request, 1 = Yes
	I	=	I/O direction, 1 = Input, 0 = Output
Word 12	S	=	SRQ pending flag
	P	=	Alarm program scheduling active
	A	=	SRQ interrupt arming flag (via SRQ statement)
	# of BEQT	=	# Active BEQT entries, 0-31
	# EQT Extensions	=	# EQT Extension words, 18-255
Word 13	I	=	Initiator/Continuator flag
	A	=	EQT Extension address.

NOTE

This description assumes that DVR37 has the SRQ alarm service.

Word 13 of the HP-IB EQT entry contains the address of the HP-IB EQT Extension which consists of 18 fixed words plus an additional 7n words where n is the number of devices on the bus. The extension may use a maximum of 255 words (See lower byte of EQT 12). Figure A-2 shows the EQT Extension format.

	Word	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	1	CURRENT I/O BUFFER SIZE IN BYTES															
	2	CURRENT I/O BUFFER ADDRESS															
	3	CURRENT I/O NEGATIVE BYTE COUNT															
	4	E	PENDING TRANSMISSION LOG														
	5	PENDING EQT															
	6	ADDR. OF BEQT FOR PENDING SRQ															
	7	COUNT OF BEQT FOR PENDING SRQ															
	8	I/O RESUME ADDR. OF DVR 37															
	9	DUMMY TIME OUT VALVE = 0															
	10	COMMAND BUFFER WORD 1															
	11	COMMAND BUFFER WORD 2															
BEQT 1 –	12	S	R	D	I	J	O	P	E				UNIT #				
BEQT 2 –	13	S	C	1	1	1	1	1	1		2	2	2	2	2	2	2
BEQT 3 –	14	C	3	3	3	3	3	3	3	C	4	4	4	4	4	4	4
BEQT 4 –	15	C	5	5	5	5	5	5									
BEQT 5 –	16									S	S	S	S	S	S	S	S
BEQT 6 –	17	ARBITRARY VALUE TO BE PASSED TO SRQ PROG.															
BEQT 7 –	18	F	C	C	C	C	C	C	C		P	P	P	P	P	P	P

Figure A-2. EQT Extension Fixed Area Format
(From Rev. 1940)

Besides the 18 word fixed area, the HP-IB EQT extension also consists of 7 words of information for each device on the bus. These 7 words are called the EQT Extension BEQT and are identical in format to the fixed area words 12-18 shown above. In fact, words 12-18 of figure A-2 represent BEQT 1-7 for the HP-IB itself.

Word 1, 2, and 3 are set during initiation using EQT7 and EQT8. See figure A-1.

Word 3 Negative value of byte count initially and is incremented by 1 for each byte processed for non-DMA operation.

Record type indicator rather than a character count for DMA operation.

= 0 EOI not required or EOI after last valid data byte
= −1 Odd byte record
= −2 EOI with last valid data byte

Word 4 E = 1 if previous I/O ended in error, bits 0-14 = # of bytes processed in previous I/O

Word 5 Same as EQT5 upon I/O completion, serial poll status during SRQ process.

Word 6 Address of BEQT used as working cell during SRQ process

Word 7 Negative value of # of BEQT used as working cell during SRQ process (−n to 0)

Word 8 DOIO return address for re-entrancy

Word 10-11 Temporary buffer used by DVR37 to transmit commands

Word 12 Bus configuration word (BEQT1 for bus)

S = 0 = Do not allow driver to abort a currently active I/O request in order to service an SRQ interrupt
R = 0 = Do not allow driver to attempt to restart an I/O request that was aborted
D = 0 = Disable DMA
I = 1 = Require EOI from device at end of transmission
J = 1 = Expect EOI with last data byte
O = 1 = Issue EOI at end of transmission
P = 1 = Issue EOI with last data byte
E = 0 = Allow occurrence of error to abort current program
L = 1 = Suppress LF on next output (Supplied *only* for line printer support)

Word 13 BEQT2 for bus
S = 1 = SRQ program is to be scheduled
C111111 = Character 1 of SRQ program name
C2222222 = Character 2 of SRQ program name

Word 14 BEQT3 for bus
C3333333 = Character 3 of SRQ program name
C4444444 = Character 4 of SRQ program name

Word 15 BEQT4 for bus
C5555555 = Character 5 of SRQ program name

Word 16 BEQT5 for bus
SSSSSSSS = Last read serial poll status

Word 17 BEQT6 for bus
Arbitrary value to be passed SRQ program

Note: SRQ program cannot be configured for bus.

Word 18 BEQT7 for bus
F = 1, PPPPPPPP = Error status of last operation (bits 0-7 of A-register)
F = 0, C• • • P • • • = Transmission log of last operation (bits 0-15 of B-register)

Note once again that each device on the bus also has a 7-word BEQT identical in format to that for the bus itself as described above.

CAUTION

Information in this appendix concerning bit patterns, EQT format, etc. is valid from Rev. 1940 but could be changed at any time. This especially concerns the L-bit in Word 11 of the HP-IB EQT entry and Word 12 of the HP-IB EQT Extension. It is recommended that the L-bit not be used (i.e., checked, set, etc.) in programming the bus or any devices on the bus.

READER COMMENT SHEET

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RTE Driver Manual

59310-90063 **July 1981**

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